CLAIMS

1.   Apparatus for associating gaze data representative of the location of gaze of an operator with classifications of images of an operator looking at different locations, comprising:

a receiver operable to receive a video stream defining a sequence of images representative of an operator at different points in time;

a classification unit operable to assign one of a number of classifications to images in the video stream received by said receiver, said classification unit being operable to assign the same classifications to images of an operator looking at the same locations; and

a calibration unit comprising:

a classification store configured to store data identifying the pairs of different classifications assigned to pairs of images in a video stream received by said receiver representative of an operator at different times separated by less than a preset time period;

a gaze conversion store configured to store data associating each of said number of classifications with gaze data representative of a gaze location; and

an update unit operable to update gaze data stored

in said gaze conversion store by updating said gaze data

such   that   gaze   data   for   pairs   of   different

classifications identified by data stored in said

5   classification store identify gaze locations which are

closer together and gaze data for pairs of different

classifications not identified by data stored in said

classification store identify gaze locations which are

further apart.

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2.   Apparatus in accordance with claim 1 wherein said

calibration unit is responsive to the assignment of

different classifications to images representative of an

operator at different times separated by less than said

15   pre set time period by said classification unit to

determine whether data stored in said classification

store is indicative of said pair of classifications and

to update data stored in said classification store in

dependence upon said determination.

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3.   Apparatus in accordance with claim 2 wherein said

classification unit is operable to determine whether

classifications assigned to consecutive images in a video

stream   received   by   said   receiver   are   assigned   to

25   different classifications and to update data identifying

pairs of classifications stored in said classification store if the different classifications for a pair of consecutive images are not identified by data in said classification store.

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4. Apparatus in accordance with any claim 1 wherein said update unit is operable to determine the distance between locations identified by gaze data associated with pairs of classifications, said update unit being operable to

10   update gaze data on the basis of said determined distances and said data stored in said classification store.

5. Apparatus in accordance with claim 4 wherein said

15   update unit is operable to adjust gaze data associated with classifications identified by data in said classification store when the determined distance between the gaze locations identified by gaze data for said pair of classifications is greater than a predetermined

20   threshold.

6. Apparatus in accordance with claim 4 wherein said update unit is operable to adjust gaze data associated with classifications not identified by data in said

25   classification store when the determined distance between

the gaze locations identified by gaze data for said pair
of classifications is less than a predetermined
threshold.

5   7.   Apparatus in accordance with claim 1 wherein said
gaze data comprises a co-ordinate data, said update unit
being operable to update gaze data for classifications
by adjusting said co-ordinate data by an amount
determined utilising the difference between the co-
10   ordinates associated with selected pairs of
classifications.

8.   Apparatus in accordance with claim 7 wherein said
update unit us operable to adjust gaze data associated
15   with a pair of classifications identified by data in said
classification store when the distance between the
locations identified by said gaze data is more than a
predetermined threshold by adjusting the gaze data for
at least one of said pair of classifications utilising
20   the following equation:

$$\overline{P}_{update} = \overline{P}_{old} - \frac{1}{\sigma}\left(\overline{P}_{other} - \overline{P}_{old}\right)$$

where

$\overline{P}_{update}$ is a vector representing the updated gaze data

$\overline{P}_{old}$ is a vector representing the data being updated

$\overline{P}_{other}$ is a vector representing the gaze location data

of the other point in the pair of classifications

and σ is a predetermined value.

9.   Apparatus in accordance with claim 7 wherein said update unit is operable to adjust gaze data associated with a pair of classifications not identified by data in said classification store, when the distance between the locations identified by said gaze data is less than a predetermined threshold by adjusting the gaze data for at least one of said pair of classifications utilising the following equation:

$$\overline{P}_{update} = \overline{P}_{old} + \frac{1}{\sigma}\left(\overline{P}_{other} - \overline{P}_{old}\right)$$

where

$\overline{P}_{update}$ is a vector representing the updated gaze data

$\overline{P}_{old}$ is a vector representing the data being updated

$\overline{P}_{other}$ is a vector representing the gaze location data

of the other point in the pair of classifications

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and σ is a predetermined value.

10. Apparatus in accordance with claim 1 further comprising:

10   a display operable to display a user interface including a pointer;

a control device operable to control the location of said pointer on said display, said control device being operable to enable a user to select portions of

15   said display utilising said pointer; and

a monitoring unit operable to monitor the selection of portions of said display utilising said control device, and to update gaze data associated with the classification of an image an operator obtained when a

20   selection of a portion of the display is made using the

control device utilising data identifying the location

of the portion of the display selected.

11. Apparatus in accordance with the claim 10 wherein

5 said control device comprises a mouse, said selection of

a portion of the display being initiated by clicking a

button on said mouse.

12. Apparatus in accordance with claim 1 further

10 comprising:

a display operable to display a plurality of user

interfaces identifying particular portions of said

display,

wherein said calibration unit is operable to

15 associate classifications of images obtained when a user

interface identifying a particular portion of the display

is shown with gaze data identifying the location of the

portion of said display identified by said user

interface.

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13. Apparatus in accordance with claim 1 further

comprising a data store operable to store data

identifying the frequency with which images are

associated with each of said classifications, said

25 calibration unit being operable to update gaze data

stored in said second data store by applying a selected transformation to said gaze data on the basis of said data stored in said data store.

5   14. Apparatus in accordance with claim 12 wherein said selected transformation comprises a transformation defining a reflection, a rotation, a translation or a combination of a reflection, rotation and a translation.

10   15. Apparatus in accordance with claim 1 wherein said classification unit comprises a self-organising map.

16. Apparatus in accordance with claim 1 further comprising an output unit operable to output for a video

15   stream received by said receiver a sequence of gaze data comprising gaze data associated by said gaze conversion store with the classifications assigned to each image in said video stream by said classification unit.

20   17. A method associating gaze data representative of the location of gaze of an operator with classifications of images of an operator looking at different locations, comprising:

receiving a video stream defining a sequence of images representative of an operator at different points in time;

assigning one of a number of classifications to images in the received video stream, wherein the same classifications are assigned to images of an operator looking at the same locations;

storing data identifying the pairs of different classifications assigned to pairs of images in a received video stream representative of an operator at different times separated by less than a preset time period;

storing data associating each of said number of classifications with gaze data representative of a gaze location; and

updating stored gaze data by updating said gaze data such that gaze data for pairs of different classifications identified by stored data said gaze data identifies gaze locations which are closer together and gaze data for pairs of different classifications not identified by stored data are updated to identify gaze locations which are further apart.

18. A method in accordance with claim 17 further comprising responding to the assignment of different classifications to images representative of an operator

at different times separated by less than said pre set
time period by determining whether stored data identifies
said pair of classifications and updating said stored
data in dependence upon said determination.

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19.   A method in accordance with claim 18 wherein said
determination   comprises   determining   whether
classifications assigned to consecutive images in a
received   video   stream   are   assigned   to different
10   classifications and updating said stored data comprises
storing   data   identifying   the   pair   of   different
classifications if the different classifications for a
pair of consecutive images are not already identified by
stored data.

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20.   A method in accordance with claim 17 wherein said
updating stored gazed data comprises determining the
distance between locations identified by gaze data
associated with pairs of classifications, and updating
20   gaze data on the basis of said determined distances and
said stored data.

21.   A method in accordance with claim 20 wherein said
updating stored gaze data comprises adjusting gaze data
25   associated with classifications identified by stored data

when the determined distance between the gaze locations identified by gaze data for said pair of classifications is greater than a predetermined threshold.

5   22. A method in accordance with claim 20 wherein said updating stored gaze data comprises adjusting gaze data associated with classifications not identified by stored data when the determined distance between the gaze locations identified by gaze data for said pair of
10   classifications is less than a predetermined threshold.

23. A method in accordance with claim 17 wherein said gaze data comprises a co-ordinate data and said updating stored gaze data comprises updating gaze data for
15   classifications by adjusting said co-ordinate data by an amount determined utilising the difference between the co-ordinates associated with selected pairs of classifications.

20   24. A method in accordance with claim 23 wherein said updating stored gaze data comprises adjusting gaze data associated with a pair of classifications identified by stored data when the distance between the locations identified by said gaze data is more than a predetermined
25   threshold by adjusting the gaze data for at least one of

said pair of classifications utilising the following equation:

$$\overline{P}_{update} = \overline{P}_{old} - \frac{1}{\sigma}\left(\overline{P}_{other} - \overline{P}_{old}\right)$$

where

5      $\overline{P}_{update}$ is a vector representing the updated gaze data

$\overline{P}_{old}$ is a vector representing the data being updated

$\overline{P}_{other}$ is a vector representing the gaze location data

of the other point in the pair of classifications

10   and σ is a predetermined value.

25. A method in accordance with claim 23 wherein said updating stored gaze data comprises adjusting gaze data associated with a pair of classifications not identified

15   by stored data when the distance between the locations identified by said gaze data is less than a predetermined threshold by adjusting the gaze data for at least one of

said pair of classifications utilising the following

equation:

$$\bar{P}_{update} = \bar{P}_{old} + \frac{1}{\sigma}\left(\bar{P}_{other} - \bar{P}_{old}\right)$$

where

5        $\bar{P}_{update}$ is a vector representing the updated gaze data

         $\bar{P}_{old}$ is a vector representing the data being updated

         $\bar{P}_{other}$ is a vector representing the gaze location data

of the other point in the pair of classifications

10   and σ is a predetermined value.

26.   A method in accordance with claim 17 further

comprising the steps of:

         displaying a user interface including a pointer;

15   a monitoring user input to identify the selection

of portions of said user interface utilising said pointer

under the control of a control device, and updating

stored gaze data associated with the classification of

an image an operator obtained when a selection of a
portion of the user interface is determined to have been
made utilising data identifying the location of the
portion of the user interface selected with said pointer.

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27.   A method in accordance with the claim 26 wherein
said control device comprises a mouse, said selection of
a portion of the display being initiated by clicking a
button on said mouse.

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28.   A method in accordance with claim 17 further
comprising the steps of:

       displaying a plurality of user interfaces
identifying particular portions of a display; and

15   associating classifications of images obtained when
a user interface identifying a particular portion of the
display is shown with gaze data identifying the location
of the portion of said display identified by said user
interface.

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29.   A method in accordance with claim 17 further
comprising the steps of:

       storing data identifying the frequency with which
images are associated with each of said classifications;

25   and

updating gaze data by applying a selected transformation to said gaze data on the basis of said data identifying the frequency with which images are associated with each of said classifications.

30. A method in accordance with claim 29 wherein said selected transformation comprises a transformation defining a reflection, a rotation, a translation or a combination of a reflection, rotation and a translation.

31. A method in accordance with claim 17 further comprising the steps of:

outputting for a received video stream a sequence of gaze data comprising gaze data associated with the classifications assigned to each image in said video stream.

32. A data carrier storing computer implementable process steps for causing a programmable computer to perform a method in accordance with claim 17.

33. A data carrier in accordance with claim 32 comprising a computer disc.

34. A data carrier in accordance with claim 32 comprising an electric signal transferred via a network.

35. A computer disc in accordance with claim 33 wherein said computer disc comprises an optical, magneto-optical or magnetic disc.

36. Apparatus for classifying images comprising:

a receiver operable to receive image data defining images;

a patch generation module operable to generate for a number of points in an image defined by image data received by said receiver, image patches, said image patches being derived by processing image data defining portions of said image which include said points, a plurality of different image patches being derived for each of said points;

a patch comparison module operable to compare stored data with image patches generated by said patch generation module to identify stored data which most closely corresponds to said generated patches; and

a classification unit for generating a classification of an image defined by image data received by said receiver, wherein said classification comprises data identifying points in an image and for each of said

points, data identifying stored data determined to most closely correspond to an image patch derived by said patch generation module from image data defining a portion of the image including said point.

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37. A method of classifying images comprising:

receiving image data defining images;

generating for a number of points in an image defined by received image data, image patches, said image

10 patches being derived by processing image data defining portions of said image which include said points, a plurality of different image patches being derived for each of said points;

comparing stored data with said generated image

15 patches to identify stored data which most closely corresponds to said generated patches; and

generating a classification of an image defined by received image data, wherein said classification comprises data identifying points in an image and for

20 each of said points, data identifying stored data determined to most closely correspond to an image patch generated from image data defining a portion of the image including said point.

38. Apparatus for comparing colour images independently of the illumination of a subject object in said images, comprising:

a receiver operable to receive image data defining images, said image data comprising colour data for a plurality of pixels representative of the colours of a subject object appearing in said images;

a processing unit operable to derive from image data received by said receiver, a colour reflectance image said colour reflectance image comprising colour data for said plurality of pixels representative of the contribution to the colour of a subject object in an image not arising due to the colour of the illumination of the subject object in said image, said processing unit being operable to derive said colour reflectance image such that the ratios of colour data of pixels in said colour reflectance image for a said subject object are independent of the colour of the illumination of said subject object in said image; and

a comparator operable to compare generated colour reflectance images with stored image data to determine the correspondence between said stored data and said generated images;

wherein said correspondence is determined on the basis of the comparison of the ratios of colour data for

pixels in a said generated colour reflectance image and corresponding ratios of colour data for pixels of said stored image data.

5   39. A method of comparing colour images independently of the illumination of a subject object in said images, comprising:

receiving image data defining images, said image data comprising colour data for a plurality of pixels

10   representative of the colours of a subject object appearing in said images;

processing a received image to derive from received image data a colour reflectance image said colour reflectance image comprising colour data for said

15   plurality of pixels representative of the contribution to the colour of a subject object in an image not arising due to the colour of the illumination of the subject object in said image, said processing being such to derive said colour reflectance image such that the ratios

20   of colour data of pixels in said colour reflectance image for a said subject object are independent of the colour of the illumination of said subject object in said image; and

comparing generated colour reflectance images with
stored image data to determine the correspondence between
said stored data and said generated images;

wherein said correspondence is determined on the
5   basis of the comparison of the ratios of colour data for
pixels in a said generated colour reflectance image and
corresponding ratios of colour data for pixels of said
stored image data.

10   40. Apparatus for associating data indicative of the
orientation of a person's head with classifications of
images of a person's head comprising:

a receiver operable to receive a video stream
defining a sequence of images of a person's head;

15   a classification unit operable to assign one of a
number of classifications to images in the video stream
received by said receiver, said classification unit being
operable to assign the same classifications to images of
a person's head in substantially the same orientations;

20   and

a calibration unit comprising:

a classification store configured to store data
identifying pairs of different classifications assigned
to pairs of images in a video stream received by said

receiver representative of a person's head at different times separated by less than a reference time period;

a conversion store configured to store data associating each of said number of classifications with data representative of at least one head orientation; and

an update unit operable to update data stored in said conversion store by updating said data such that data for pairs of different classifications identified by data stored in said classification store identify head orientations which are closer together and data for pairs of different classifications not identified by data stored in said classification store identify head orientations which are further apart.

41. A method of associating data indicative of the orientation of a person's head with classifications of images of a person's head comprising:

receiving a video stream defining a sequence of images of a person's head;

assigning one of a number of classifications to images in the received video stream, wherein the same classifications are assigned to images of a person's head in substantially similar orientations;

storing pair data identifying pairs of different classifications assigned to pairs of images in a received

video stream representative of a person's head at different times separated by less than a reference time period;

storing association data associating each of said number of classifications with data representative of at least one head orientation; and

updating said association data such that association data for pairs of different classifications identified by stored pair data identify head orientations which are closer together and association data for pairs of different classifications not identified by stored pair data identify head orientations which are further apart.

42. Apparatus for associating data indicative of the viewing direction of a person's eyes with classifications of images of a person's eyes comprising:

a receiver operable to receive a video stream defining a sequence of images of a person's eyes;

a classification unit operable to assign one of a number of classifications to images in the video stream received by said receiver, said classification unit being operable to assign the same classifications to images of a person's eyes in substantially the same viewing directions; and

a calibration unit comprising:

a classification store configured to store data
identifying pairs of different classifications assigned
to pairs of images in a video stream received by said
receiver representative of a person's eyes at different
5   times separated by less than a reference time period;

a conversion store configured to store data
associating each of said number of classifications with
data representative of at least one viewing direction;
and

10   an update unit operable to update data stored in
said conversion store by updating said data such that
data for pairs of different classifications identified
by data stored in said classification store identify
viewing directions which are closer together and data for
15   pairs of different classifications not identified by data
stored in said classification store identify viewing
directions which are further apart.

43. A method of associating data indicative of the
20   viewing   directions   of   a   person's   eyes   with
classifications of images of a person's eyes comprising:

receiving a video stream defining a sequence of
images of a person's eyes;

assigning one of a number of classifications to
25   images in the received video stream, wherein the same

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classifications are assigned to images of a person's eyes

in substantially similar viewing directions;

storing pair data identifying pairs of different

classifications assigned to pairs of images in a received

5   video stream representative of a person's eyes at

different times separated by less than a reference time

period;

storing association data associating each of said

number of classifications with data representative of at

10   least one viewing direction; and

updating said association data such that association

data for pairs of different classifications identified

by stored pair data identify viewing directions which are

closer together and association data for pairs of

15   different classifications not identified by stored pair

data identify viewing directions which are further apart.